

Abstract

The aim of this paper is to examine my personal experience and practice in operating theatre photography, mainly orthopaedics and cosmetic/aesthetic surgery including for medicolegal purposes, to provide an overview to support other photographers undertaking this work. The ways of working are very much personal but should help others in undertaking this type of photography.

Introduction

There are still very few papers about operative or surgical photography the key ones are those by Morris in 1995¹ and 1996² which have an American slant to some aspects and Bryson in 1999³ looking specifically at photographing personal injury cases, the chapter by Williams and Nieuwenhuis in 1992⁴ on Clinical and Operating Room Photography is strong on the clinical side with less information about operative photography. Other than these the literature consists of 'how to' papers for surgeons or others often just quick guides to cameras and how to use them. This is despite operative photography being a key part of clinical photographer's role in any general or specialised teaching hospital.

I must admit to a distinct advantage in working in the operating theatre as I spent a year working as Theatre Porter in 1976 when the range of work was more like that of an Operating Department Assistant than purely taking patients to and from theatre. Working in an operating theatre environment enables you to learn from the inside how things function, how surgical teams work together and the nuances of what you should and shouldn't do.

Purpose of theatre photography

This is really just a clarification but there is more to how operative records are used than may be expected.

- Patient records
- Recording of new operative techniques for journals, book publication and as part of research protocols.
- Medicolegal records for civil or criminal cases⁵.
- Teaching materials for trainee doctors and surgeons⁶.
- Patient education⁷ and explanation post-operatively including for television programmes to go alongside videos e.g. 'Your Life in their hands'.
- Commercial for equipment manufacturers towards marketing and sales, including surgical training.

General views of theatre and equipment

Photographs are often taken of the general operating environment for press and publicity, teaching roles in a working theatre or operating techniques and for showing patients undergoing surgery under local anaesthesia how they will be protected from seeing the operation. The key problem in any operating theatre is mixed lighting. The actual mix will vary with different circumstances, and in some theatres with the time of day, but can be any number of a combination of colour temperatures, see Table 1.

The best solution is the same as that used for lighting a person sitting at a computer monitor, a combination of slow shutter speed together with flash. Choose a shutter speed of 1/15 second or longer to ensure no banding on TV monitor. Using this shutter speed choose the correct exposure for the monitor usually between f/5.6 and f/8, depending on ISO selected. Then set flash to automatic f/5.6 or f/8 so using a combination of available light and flash to override the theatre light. There are two problems with the image this produces often you will get a certain amount of green coming through from the fluorescent tubes on the ceiling also you

may get a hot spot from the way the operating theatre light is being focused on the operating field.

| Light source | Colour |
|---------------------------------------|---|
| Natural light from windows | Colour dependent on time of day and outside weather conditions. |
| General room lighting | Fluorescents, often with a slightly greenish tinge using daylight white balance |
| Operating light | Often tungsten illumination |
| Television monitor i.e. for endoscopy | Daylight but may on occasions emit a greater amount of blue light. |

Table 1 – Light sources and colour balance

Lighting in the operating theatre may often be subdued with light only provided by the operating light and separate light for equipment trays, an operating microscope or in endoscopy only the fibre optic light and the TV monitor. An example is the subdued lighting and microscope used in intraocular surgery or for microsurgery. Flash photography in these situations could be disturbing for the consultant or patient if the operation is under local anaesthesia, so may need to use available light. Using a digital camera this is easier as can adjust the ISO to allow for sufficient depth of field and exposure in low light situations even if this does introduce some noise into the image. Where tungsten lighting is being used, for example with the surgical microscope, the camera white balance should be adjusted e.g. to 3200°K.

The photographer and his equipment

You and your equipment constitute a hazard within the working environment of the operating theatre. How you behave and work go towards ameliorating the dangers you pose. You should make yourself aware of the particular protocols for going into and out of theatre at the hospitals you cover in advance of your visit. The protocols will be stricter in situations where there are a large number of theatres working simultaneously.

Working in theatre is a bit like being invited to a sophisticated party you should behave impeccably and try not to put a foot wrong with the hostess (the scrub nurse in charge of the operation) or the guest of honour (the consultant surgeon) and get along with the other staff and guests in that way you can be sure you will be invited back.

Equipment

The usual cleaning procedures should have been carried out before your equipment comes into theatre to prevent cross-infection. However, the dangers go beyond this, it is inevitable that you will have to put your equipment down somewhere if you have brought everything you can possibly need including extras of everything. Each operating theatre set-up will be different but you should find somewhere close to where you are working, e.g. same side of the theatre as you are photographing, to put your equipment down. The floor is the usual position preferably (depending on which battery system you are using) close to an electrical socket and where no one is likely to walk past and trip over your case. Make sure it is not near water or other hazards, for example just below a shelf or board that theatre staff need to access. Think before you put your case down and if you are unsure check with the scrub nurse and her team.

Keep things tidy and compact don't have equipment flowing out of your case and onto the floor and surrounds. If concerned about water or other fluids always close the lid of your case back down. A hard case with a washable surface is preferable.

Person

You do need to familiarize yourself with operating room procedures. Just watching a number of operations will help you understand how an operation works but don't forget that each specialization has its own way of working. If you only go in to theatre to take a photograph then go, and if this is on an irregular basis say once a month or less it will take you a long time before you become confident as a surgical photographer. You have to become part of the working team to fully integrate your photography into operative practice.

You and your equipment

When you are carrying all your equipment think about where it is about your body and where the cables are hanging. Try to keep the cables from powerpack to flash and flash to camera from flapping around. You can wrap them around your arm or make sure you use cables with coils and that the coils haven't become too loose due to stretching. The real weakness of the system is often the flash connector; so it is preferable to use a cable with a hotshoe connector as it is less likely to pull out or drop while you are working.

It is important to be aware of your body and where you are putting yourself. If you accidentally touch part of the sterile area don't keep quiet about it let someone know and they can put an extra towel over the area. If you know you are going to touch an area to get a particular view that is needed i.e. you need to lean across the patient and so touch the sterile towels let the team know and they can put an extra towel in place which they can then remove after you have finished.

Methods of working

Occasional surgical photography

How you work or collaborate with a consultant will depend on your working relationship. If you only take the occasional photographs for a consultant he/she will know what they want you to do and request it when you get into theatre. When you go into a theatre for this type of request you should make your presence known to the sister or other member of staff acting as scrub nurse as they are in charge of the operating theatre and the operation itself. They will then inform the consultant/surgeon of your presence. If you cannot attract their attention you may need to talk to the staff providing the equipment and other items, the runners.

In this situation it will be operate - stop for photograph - operate - stop for photograph and so on which means the operation may take longer than normal. This can have consequences where timing of the operation is critical for example in orthopaedics and hand surgery and one or two other specializations. They are different in that they often work with a tourniquet, see Figure 1, to provide a bloodless field of view but this does place a limit on the length of the operation, so photography should not delay or extend a procedure.

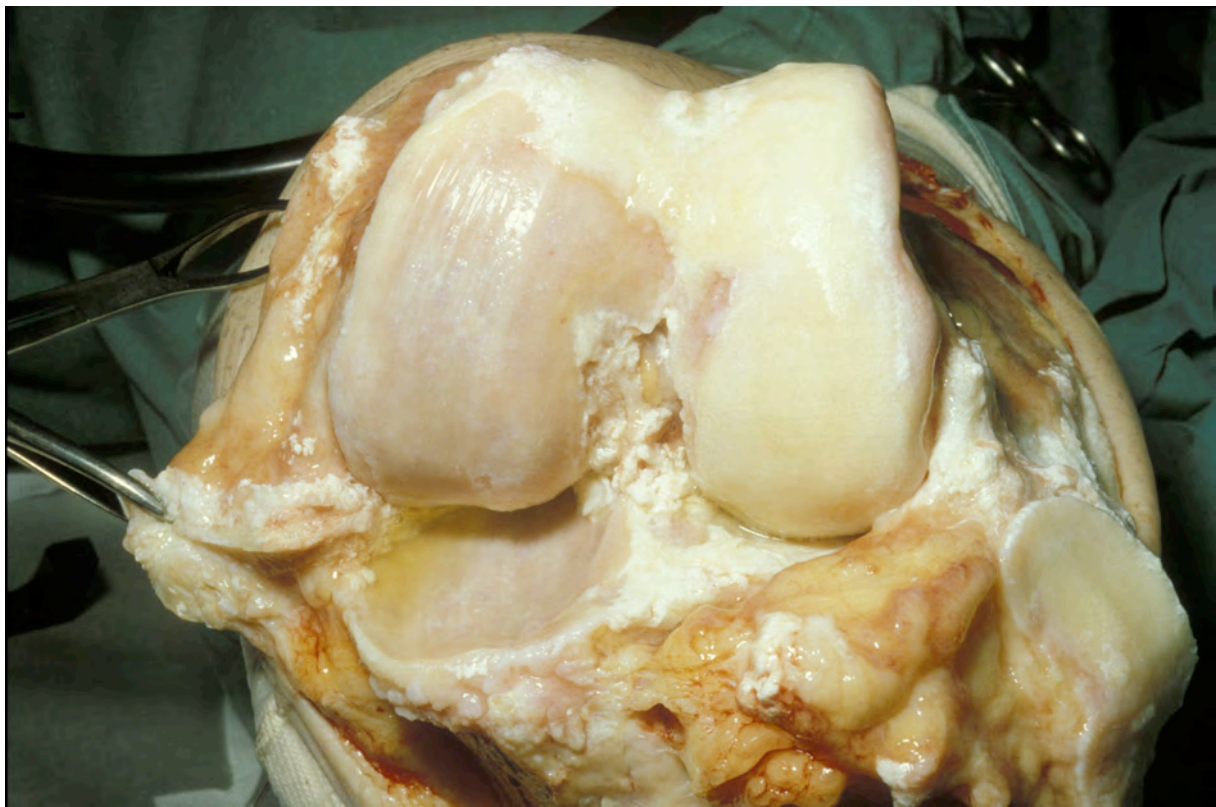


Figure 1 Photograph of knee with severe osteoarthritis before a unilateral knee replacement showing bloodless field of view from a tourniquet, note also the white shiny nature of cartilage.

Working continuously in theatre

If, as I have worked in the past, I am in theatre for a whole operating list working and recording as part of the team I would be photographing what I know the consultant needs for teaching or demonstration of a condition or procedure as he operates.

This relies on several things:

1. That the photographer knows enough about the operation/condition to know what is needed. In this context it is always useful to watch a specific operation before trying to photograph it.
2. The consultant is aware of the photographer and any additional views he requires as the operation proceeds.
3. In this working relationship consultant and photographer we are working in tandem so I am photographing as he/she is working without them stopping for me.

Advantages

The advantage of this way of working is that the consultant does not have to slow down or take time out for the photographer. This means that if he does want something photographed he doesn't really have to say so he just makes the opportunity for the photograph available knowing that I am at the same place in the operation as he is. This is easier if there are fewer watchers and hangers on (Junior doctors) getting in the way.

Whilst it would be ideal for the operation site to be clean of blood and free of swabs this is not always possible. However, when you get used to how a consultant works they need a blood free view so you just photograph immediately after they have used a swab to clear their view, so you can work in sync.

Disadvantages

I may not have exactly the same viewpoint and some views may include swabs and other items affecting the composition. Swabs are white and often show up glaringly in photographs. If you need a specific view always ask for it to be cleared of swabs. Often this will be one of the jobs of the surgical assistant whether registrar or house surgeon helping the consultant. Another disadvantage of this approach is that the consultant may not realize the complexities of what you are doing so if you are not there they cannot understand why they can't get the same results with the theatre general use camera or any other camera they try and use.

Photographic techniques

Lens choice and views of the operating field

There is a significant difference between the set of lenses I used to work with and the lenses now available due to the increased availability of high quality zoom lenses. This means that it is possible to carry one lens that will cover most situations in theatre.

Most of my surgical photography I carried out using either a Nikon 55 mm micro lens for standard views and Nikon 200 mm micro for close-ups. The were both calibrated when working with a Metz 45 CT2 on full-power (Early versions did not include 1/2 and 1/4 full power settings) to give exposures ranging from f/22 to f/32. The maximum automatic flash for the Metz is f/16 which is fine except where looking at close-ups and trying to get half life-size (maximum magnification of 200mm micro with 35mm format film).

Handheld flash

The real advantage of a 200 mm lens is that it is possible to get a general view of an area even when having to photograph from outside the equipment trolleys i.e. about 3 metres away. Using a telephoto lens is a great advantage as the working distance is longer but you can still obtain a decent close-up, Figure 2. However, using this lens does depend on having a height advantage i.e. being over 6' tall does really help.

This lens also allows you, especially if the consultant is seated and you are tall enough to work over the consultant's shoulder to get a similar view to him/her but not be touching them or distracting them while they operate.

This kind of combination or a wide angle zoom plus a telephoto are still useful as telephoto zooms tend not to have a sufficient close-up facility or they only go down as far as f/22 in terms of aperture.

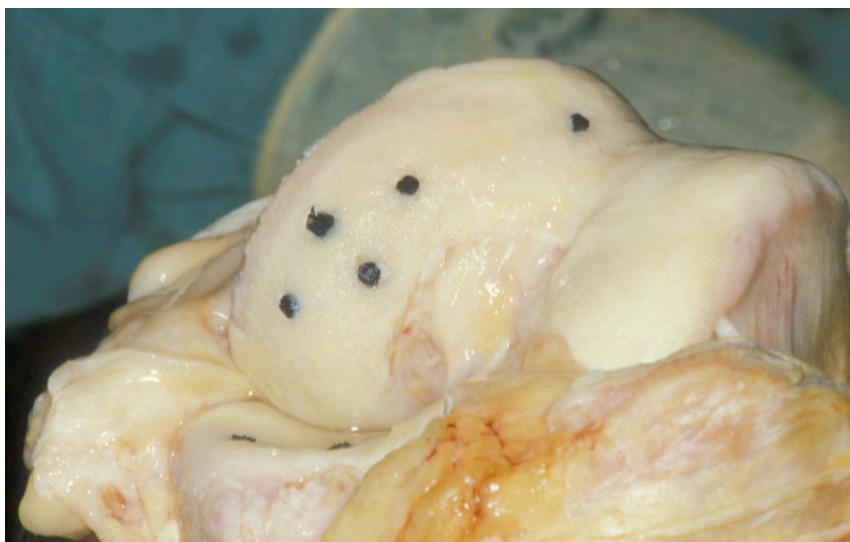


Figure 2 Oblique view of the knee joint using 200mm micro lens. The joint is in focus but obtrusive elements like the surgeon's glove and arm are out of focus.

Exposure

In orthopaedics, especially where open surgery is being performed of joints, I would underexpose by as much as 1/2 a stop also depending on your camera/flash combination it may be necessary to use a 2B filter to reduce the quantity of ultraviolet/blue from the flash. This is because when photographing cartilage it is very easy to get a totally white surface without detail, see Figures 1 and 2. You could compare the photography of cartilage with trying to photograph snow or white porcelain, but with the added difficulty of the surface being shiny with synovial fluid.

There are certain aspects of medical photography which require a great deal of dexterity, coordination and in some situations strength; using a hand held flash together with a camera and lens is one of those as if you want modelling the flash will have to be held off camera at an angle to the subject while the camera is held still. So you have to know where your flash hand is so that it is covering what you need when you take the photograph, but still provide modelling to the subject.

Close-up photography is easier as here it is best to have the flash close to the end of the lens. With the lens set at a specific magnification it is then possible to move backwards and forwards until you are in focus. Generally working with handheld flash it is better to set your lens to the distance you need first otherwise you would need three hands.

Operative sequences

Working with a set magnification/subject distance it is possible to move from pre-operative standardized views to operative views back to standardized post-operative views to give a consistency in demonstrating a specific clinical condition or operative technique. In creating an operative sequence do not start too close in case the field of view has to increase. In some operations the first incision will be fine on other occasions it has to be extended to give a better operative view for the consultant.



Figure 3 Operative sequence removal of breast prosthesis and repair of weakened dermal tissue before replacement with new breast implant.



Figure 4 Superior view of the patella taken in the anaesthetic room prior to surgery in a) normal position and b) dislocated.

Photography in the anaesthetic room

In orthopaedics is common for a consultant to examine a patient in the anaesthetic room before the surgery starts this can be for a number of reasons:

1. The examination would be painful for the patient if done while they were awake, for example pivot shift test and extent of varus and valgus⁸.
2. The muscle relaxants from the anaesthesia allow the full extent of a condition to be visualized without the natural tensing up of a patient on normal examination for example, see Figures 4a and b

It can also be useful for some of these examinations to be photographed for teaching purposes or to show the patient post-operatively.

Photography of surgical specimens

Although we would all like the time to photograph specimens in the studio usually, and quite rightly, they go to pathology first so working in theatre and taking photographs of specimens there may be the only opportunity you have to photograph them. In the theatre there is a good supply of green towels for backgrounds and if the specimen is wet or oozing, use sterile water to wet the green towel before you place the specimen onto it. It is always worth carrying set of scales with you into theatre for specimens or you can use the end of an instrument e.g. forceps for comparative purposes. Photographing in theatre also opens up the possibility for the specimen to be cut or opened while you photograph it to demonstrate the type of pathology concerned, see Figures 5a and b.



Figure 5 Specimen photographed in the operating theatre a) Whole cyst b) Cyst opened to show sebum.

Conclusion

There is still a great need for good operative photographs for updated procedures, new techniques, new implants and materials, unusual cases, teaching materials, medicolegal or even forensic purposes. So learning how to work in theatre should be important for every

References

-
- ¹ Morris, M.A. Photography in the operating room, a primer: Part 1-- The environment and equipment. *J Bioi Photo gr.* 1995 Oct;63(4):77-83.
- ² Morris, M.A. Photography in the operating room, a primer: part 2--photographic technique. *J Bioi Photo gr.* 1996 Jul;64(3):51-6.
- ³ Bryson, D. Operating theatre photography in personal injury cases. *Journal of Audiovisual Media in Medicine* 1999; 22 (2): 75-82.
- ⁴ Williams, A.R. & Nieuwenhuis, G. Clinical and Operating Room Photography. In Vetter, J.P. *Biomedical photography*. London: Butterworth-Heinemann, 1992.
- ⁵ Ibid
- ⁶ Edwards, S. & Rajaratnam, V. Digital Video Documentation as Evidence of Clinical Skill Acquisition. *Journal of Visual Communication in Medicine*, 2009; 32 (3–4): 78-85
- ⁷ Reid, G.D. & Leong, A. Operative photography in gynaecological endosurgery. *Medical Journal of Australia* 2001; 174: 285-287.
- ⁸ Bryson, D. Operating theatre photography in personal injury cases. *Journal of Audiovisual Media in Medicine* 1999; 22 (2): 75-82.